NASA

RESOURCES GUIDE FOR PERFORMANCE MEASUREMENT IN NASA WORK GROUPS

PREPARED FOR THE NASA PRODUCTIVITY PROGRAMS OFFICE

by
Dennis C. Kinlaw, Ed.D

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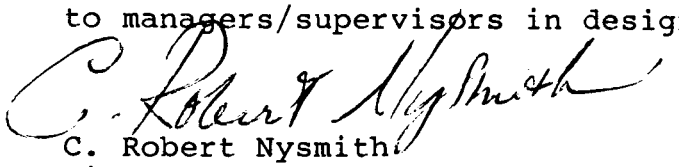
FOREWORD

This "Resources Guide" was initiated by the NASA Productivity Programs Office to aid supervisors and managers in understanding and overcoming resistances to measuring organizational performance and to encourage the uses of such measurement as part of good management.

The development and use of meaningful measures is very difficult and little information is available for measuring the performance of scientific and engineering services. It is hoped that the information contained in this Guide will encourage and be helpful to managers/supervisors in designing and using group measures.



C. Robert Nysmith
Director, NASA Productivity Programs

INTRODUCTION

Executive Order 12552, dated February 25, 1986, requires that NASA, along with 23 other executive departments and establishments, design and implement a productivity improvement program. Section 5 of the Executive Order places overall direction of the program with the Office of Management and Budget (OMB) and authorizes the Director of the Office of Management and Budget to set productivity goals, policies, principles, standards, and guidelines for the administration of the order. OMB Bulletin Number 87-12 requires that productivity improvement plans include systems which measure each function that an agency will use to gauge quality, timeliness, and efficiency.

Independent of OMB Bulletin 87-12 and anticipating its requirements, NASA has affirmed in its "Productivity Improvement and Quality Enhancement Management Themes" that "Management should support the processes for developing micro-measures of productivity and quality at the group level." In addition, the agency has undertaken several preliminary initiatives to build the knowledge and skill base from which measurement systems might be built. The general purposes of these initiatives have been to (1) understand better how to develop work group performance, measures, (2) develop some common methods for deriving group measures that can be tested by NASA managers, and (3) train NASA managers and NASA contractor managers how to design and use group performance measures. This Resources Guide is one such initiative and is intended both to help NASA managers develop measures and to encourage them to add to our growing understanding of how to develop and use group measures.

Objectives

The specific objectives of this Resources Guide are as follows:

1. Initiate a process for collecting resources for work group performance measures that can be easily accessible to NASA managers.

2. Communicate the results of one small-scale project which was directed at developing group measures.

3. Identify payoffs that managers can expect from developing and using group measures.

4. Provide guidelines for undertaking a measurements project within a work group.

5. Outline a proven group process for developing measures.

6. Provide descriptive models of group measurement ratios.

7. Describe examples of ratios that have been developed by NASA managers and work group members.

This Resources Guide does not purport to be the "one best way" to design useful measurement ratios. The development and use of measures is a very difficult task and the information about measuring the performance of scientific and engineering services is still limited.

Scope and Limitations

The material included in this initial issue of this Resources Guide provides a summary of the results of one NASA-sponsored measurement research project and the lessons learned from teaching NASA managers and NASA contractor managers how to design measures during NASA's Productivity Improvement and Quality Enhancement Seminar. The focus is primarily on the development of micro performance measures for work groups at the Branch level. It is expected, however, that the information contained in this Guide can be applied at the Division, Directorate, and comparable agency organizational levels.

As information becomes available from other projects and sources, additions and updates will be made to this Guide.

Sources

The primary sources for initiating this Guide are (1) a Small Scale Measurements Study conducted by the author and (2) NASA's Productivity Improvement and Quality Enhancement Seminar designed and conducted by the author at three NASA installations (principally at Kennedy Space Center) over a 2-year period. Descriptions of these sources are found in Appendixes A and B. In addition, a literature search was conducted by Langley Research Center's Technical Library. Reading resources from this search are listed in Appendix C.

DEFINITIONS

Such words as productivity, quality, and performance have no universally accepted definitions. The operational definitions of these and other terms used in this monograph are listed below.

Effectiveness

Refers to the degree of success achieved in reaching pre-determined goals or the success achieved in responding to demands placed on a work group.

Efficiency

Describes the degree to which pre-determined goals are achieved in a timely and economic way.

Measurement

Designates any of a variety of ratios that compare one performance variable with another, e.g., carloads per man-hour, ton-miles per gallon, pounds of extrusion per billet pounds, and work authorization documents closed per engineering design cost.

Performance

Refers to the measurement of a work group's total output relative to quality, quantity, timeliness, efficiency, effectiveness, and safety.

Productivity

A measurement of services and products compared to cost.

Quality

A measurement of performance compared to desired or stipulated specifications.

Content of the Guide

This Guide is organized so that two preliminary topics are discussed, payoffs from measurements and resistances to measurement, and then a small group method for designing measures is introduced. The section on method is followed by a detailed analysis of several different kinds of measurement ratios that can be used to track performance.

When the group method is employed, the information on payoffs, resistances, and ratios is critical to the successful use of the method. The Guide can be used, therefore, as a step-by-step reference for any work group that desires to develop and test measures.

OVERCOMING RESISTANCES TO PERFORMANCE MEASUREMENT

Any work group which successfully identifies and uses performance measures will encounter and overcome the resistances that work group members have to performance measurement. The first step is to recognize the resistances and the second step is to use the general strategies to overcome these resistances.

A number of resistances were reported in the three projects which form the major resources for this monograph. Resistances fall into the following general categories:

- o Disbelief about the possibility of developing useful measures
- o Fear about the use and abuse of measures

Disbelief

Managers in highly complex engineering and research work environments (like NASA) often approach the task of designing and using measures with serious doubt. They believe their jobs are so varied, unpredictable, and produce such esoteric results that the true outcomes of these jobs cannot be measured.

Doubt about the possibility of developing measures has two primary sources. The first is "guilt by association" and the second is the lack of skill.

Many NASA employees, especially NASA managers, associate work group performance measures with their own experiences with NASA's performance appraisal system--in particular, they associate measures with Key Specific Objectives. A large number of NASA managers believe that their performance appraisal system has had a neutral or even negative impact on their own performance and the performance of their associates. Part of their negative feelings spring from the lack of credibility that the Merit Pay System has. But part of this belief also derives from their experience that the measurement of their performance has been largely subjective and arbitrary. The conclusion that these managers make is obvious. If our individual performance cannot be measured, how can group performance be measured?

A related source of disbelief about the possibility of designing useful measures is that NASA managers have not worked the problem with sufficient effort and resources to build the needed skill level to develop useful measures. Quite simply put, NASA managers do not believe that measures can be derived because they have little or no skill in deriving such measures.

The foregoing observation leads to a kind of "catch-22" condition. Managers and other key employees resist developing measures because they do not believe such measures can be written. They cannot write such measures because they do not have the skill. They will not develop the skill until they work very hard at writing measures.

Fear

Fear is also a major source of resistance to measurement. NASA managers fear measures because (1) they are unsure who will control the use of the measures, (2) they expect measurement will become another administrative paper system that will eat away at the time they have for "real" work, and (3) they are afraid their work groups will lose even more of their already eroding autonomy.

NASA is a bureaucracy within the larger Federal bureaucracy. Managers often feel victim of the rules and administrative systems that descend upon them without their input or concurrence. NASA managers at installations are at the center of a set of widening administrative layers or shells. These managers fear decisions and controls that reside in bureaucratic layers that are far removed from their own installations. One recurring question that NASA managers have about measures is the following: will the measures be used (or abused) by some disinterested and uninvolved decision-maker who has no stake in the performance of their work groups?

A second fear of NASA managers is that group performance measures will become another time-consuming administrative paper system. Managers of research branches often consider the increase of time spent on administrative duties a more serious impediment to their performance than the lack of Research and Technology dollars. Managers are not ready voluntarily to take on what they perceive to be another administrative chore.

And, finally, a fear which is intertwined with the other fears described is that performance measurement will lead to a further loss of autonomy. Researchers fear that they will be forced to focus their efforts on just those goals that are being measured, rather than using their own judgment to pursue what they believe to be important--results.

One basis for this fear is derived from the lack of participatory planning at NASA installations. When work group results are not derived from major goals and strategies secured by consensus, the fear of the loss of autonomy is predictably aggravated.

General Principles for Overcoming Work Group Resistances

A work group's resistance to measures is obviously dependent upon the larger environment created by the whole organization. Any successful group measurement program will finally depend on the commitment to measurement demonstrated by the most senior decision-makers of the total organization. But within each work group there are certain general principles that can be used to overcome resistances to measurement.

1. Involve the whole work group. Participation in the development of measures conveys a sense of influence and control to the group. It also develops ownership within the group for the measures and increases the likelihood of acceptance.

2. Define specific time limits within which the measures will be initially tested and revised. People are more willing to design and use measures when they know that they are not operating in a "once and for all" environment. The minimum time limits within which measures can be tried and evaluated is usually about 6 months.

3. Take time for the group to find its own best way. To force a particular process upon a group for developing measures can increase the already existing resistance to measures. This monograph recommends a structured sequence for designing measures. But the work group must believe that it is in control of the process and that it can modify the sequence to suit its own sense of what will work.

4. Take advantage of improvement opportunities as they occur. The purpose of measurement is to improve performance. When groups identify opportunities to improve (e.g., identify impediments to performance that can be removed) they should be encouraged to seize these opportunities rather than being forced into some lock-step process of developing measures.

Summary

There are natural, justified, and predictable resistances in work groups to measurement. It will take an agencywide strategy to overcome fully these resistances. Productivity and quality improvement must be visible in the agency's strategic plan and the agency (at least for a defined period of time) must focus managers and resources on building measurements to stimulate and track improvement.

Work groups must, however, manage resistances to measurement within the limits of their own influence if measures are to be designed and tested. This section has provided some practical guidance for such management.

PAYOFFS FROM MEASURES

Payoffs from measures depend largely upon the kind of process used to develop measures. Processes for developing measures have the greatest payoffs when they follow the general principles outlined in the previous section.

The kinds of payoffs from developing measures that we can fully support from the Small Scale Measurements Study and the Productivity Improvement and Quality Enhancement Seminar are as follows:

1. Developing measures leads to discovering opportunities to improve performance.

2. Developing measures leads groups to take a more proactive posture to improve performance rather than "continuing to do their best."

3. Measures provide a way to give concrete feedback to a group for verifying its progress.

4. Measures establish a basis for reward and celebration.

5. Developing and using measures is an excellent tool for building teams.

Discovery

Developing measures leads groups to discover (1) what they do, (2) how well they are doing, and (3) previously unknown opportunities for improvement.

Developing measures provides the opportunity for work groups to develop a consensus about their key results as well as building a common understanding of the various internal processes through which they produce their key results. Developing measures is a forcing function. It stimulates an iterative process of stating in ever more concrete terms the precise service and product delivered. Is the key result of a test branch published papers? Or is the key result information? Or is the key result application of information? Is the key result of a safety group the number of inspections? Or is it decreases in reportable accidents?

Few work groups have a clear idea of the actual steps, inputs, and decision points in their workflow processes until they try to measure the efficiency of each step or the quality of each step's output.

One series of discoveries that all groups experience has to do with cost. Groups do not typically know what it costs to

complete a particular step in a work sequence. Groups never know, for example, what various meetings cost that are associated with their work sequences.

Proactivity

Measurement, when undertaken as a collaborative group initiative, can be counted on to lead to improved group performance. Discovery and improvement are, of course, very closely associated.

As a work group develops a common understanding of its key results and an understanding of its processes for doing work, the group will assume a more proactive stance toward improving its performance. There is a natural step from measuring what we do to improving what we do. And often this step appears inevitable.

Measurement can lead to both conscious and unconscious improvement initiatives. One group analyzed the workflow in a procurement process. Even before it set specific improvement targets, the average time in the procurement cycle decreased. It decreased further when the group removed duplicate reports, redundant reviews, and eliminated unnecessary signatures.

Verification

Measurement creates the possibility for concrete feedback concerning a work group's performance. Measurement can have the effect of giving a project flavor to the most continuous and repetitive work processes. Projects are time bound and focused activities that have specific goals and verifiable end points.

Measurements, to be useful, must be turned into sets of indexes that permit the regular comparison of performance over time. Such comparison becomes the basis for verifying performance changes and verification is the basis for celebration.

Celebration

Celebration is a major ingredient of motivation. Measurement is an important strategy for building a concrete basis for celebration. Measurement removes confusion and indefiniteness about performance.

A contract-monitoring group began the process of building measures. The process led to discovery and finally to celebration.

Until going through the process of developing measures, this group was unable to define its key results in a way that all group members understood and accepted. The group also could not

agree on the steps and actions associated with its major work flows. Initially, the group focused on its evaluation function and the two contract evaluation reports that it issued. During group meetings to build measures, the group redefined its key results as contract cost savings and contractor improvement. These cost savings and improvements became the causes of celebration.

Team Development

The emphasis on building a "team" provides a common commitment to work group results and leads to a wide variety of collaborative efforts to improve these results. Improvement becomes the basis for group celebration Taken together, improvement, collaboration, and celebration lead to pride and ownership.

Summary

Creating and using concrete performance measures can lead to a number of significant payoffs. The overall and primary payoff is, of course, improved performance. But measurement also produces a number of intermediate and associated payoffs. Among these payoffs are the following:

- Discovery
- Proactivity
- Verification
- Celebration
- Team Development

It is naivete in the extreme to think that these payoffs come easily. Building measures is a difficult and time-consuming task.

SMALL GROUP METHOD

The process described in this section for developing measures assumes the use of a trained facilitator. The process has the following phases:

1. Brief the installation's senior managers and Productivity Focal Points about the process.

2. Conduct preplanning session with work group's manager and develop agreement for ground rules and general schedule for proceeding with the process.

3. Hold initial meeting with each work group, brief each work group on the design and objectives of project, develop agreement on milestones, and complete first iteration of developing measures.

4. Hold additional meetings with work group until set of acceptable measures has been developed.

5. Set group up to collect measurement data and test the use of the measures.

6. Modify measures and data collection methods as necessary.

Small Group Sequence

There are probably a number of structured small group methods for designing performance measures. The Small Group Measurements Study experimented with several alternative small group structured sequences and methods. The method finally selected in that study was subsequently tested in over 20 iterations of the Productivity Improvement and Quality Enhancement Workshop. The steps in the sequence are as follows:

- Step #1: Acknowledge the Resistances to Developing and Using Measures.

- Step #2: Identify the Potential Payoffs from Developing and Using Measures.

- Step #3: Introduce an Open Systems Model of Organizations and Develop a General Understanding of Both Final Output and Internal Repeated Work Processes and Products.

- Step #4: Introduce Descriptions of the Five Types of Measures: Effectiveness, Quantity, Quality, Value, and Change. (See next section.)

- Step #5: Begin With Measures of Quantity and Conduct a Structured Group Brainstorming Sequence.

The sequential steps in the process may take place in one group meeting or over several group meetings.

Step #1: Acknowledge the Resistances to Developing and Using Measures.

Productivity is not a popular notion among white-collar workers in the kind of complex jobs that are typical of the aerospace industry. Measurement is a considerably less popular notion and is commonly referred to despairingly as "bean counting." The first step in the process is to identify and discuss these resistances. No attempt is made at this time to resolve these resistances. The goal of this step is to establish at least a "wait and see" attitude among the managers by acknowledging and analyzing their own experiences. Resistances that can be anticipated have been described in the section above entitled RESISTANCES TO PERFORMANCE MEASUREMENTS.

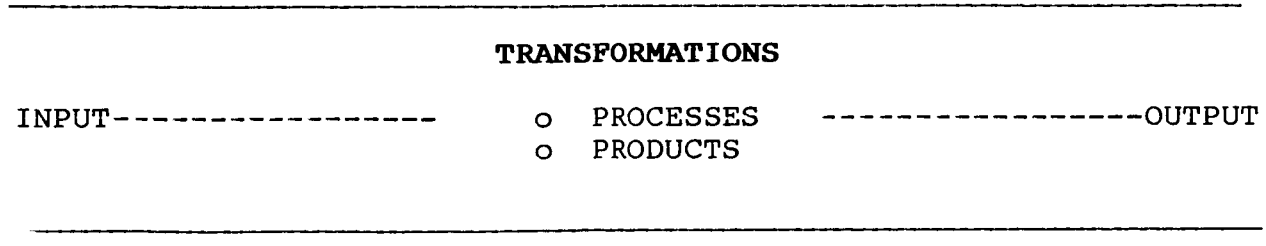
Step #2: Identify the Potential Payoffs from Developing and Using Measures.

The second step in the process is to identify potential payoffs. It is imperative that these payoffs be derived from the experience of managers from the same organizations as those participating in the process. General information about payoffs is found in the section of this monograph, PAYOFFS FROM MEASURES.

Step #3: Develop a General Understanding of Both Final Output and Internal Repeated Work Processes and Products.

The use of the open systems model, Figure 1, produces the following results: (1) groups are able to grasp quickly a picture of their total performance, i.e., one that includes the services and products that leave the groups (output or key results) and products and processes that stay within the group as tools for producing its final output or key results; and (2) groups are able to produce many possible targets for which useful data can be obtained for tracking performance.

Figure 1. Open Systems Model of Organizations



Step #4: Introduce Descriptions of the Five Types of Measures: Effectiveness, Quantity, Quality, Value, and Change.

At this step, the models of the five kinds of measures are introduced and clarified with examples. (See the next section.) Additional examples representing each element in each ratio are solicited from managers participating in the process. At the end of this step, managers have a good understanding of the various ratios and are now prepared to develop their own.

Step #5: Begin with Measures of Quantity and Conduct a Structured Group Brainstorming Sequence.

Managers can easily develop effectiveness measures. They work daily with these kinds of measures. They do not require special skill to develop these measures. They do require considerable new skill to develop the other four ratios. The easiest of the four to produce is measures of quantity. Instructions for the process to produce the ratio are as follows:

1. Review the quantity ratio model. Explain to the group that it will first develop the numerator or the ratio and then the denominator.

2. Develop by brainstorming as many possible data points for tracking performance as possible by focusing on (1) final outputs and key results or (2) on internal processes or products. A recorder lists items on chart paper as they are presented.

3. Review list and clarify each item. Next, combine items which state the same thing only in different words.

4. Have each group member assign a weight to each item based on perceived usefulness in tracking performance.

5. Transfer selected item to separate page of chart paper and draw a line under it. This is the numerator of the quantity ratio. Review this numerator again. Ensure that it clearly describes (1) a final output or (2) an internal process or product.

6. Develop by brainstorming a list of sources of costs associated with the numerator (e.g., meetings, indirect labor, time, reviews). Record on chart paper the items developed.

7. Select from the list of cost sources the ones that, if tracked, would provide clear opportunities to improve performance.

8. Review the numerator and the costs (denominator) and refine if necessary.

9. Review the measure and evaluate its utility in terms of availability of data for input to ratio; ease of using and moni-

toring; limits of information provided by ratio (what misinformation may it provide?); impact and use for improved performance.

The nine-step structured sequence outlined above can be used, with minor modifications, to develop all five kinds of measures.

MEASUREMENT RATIO MODELS

A number of different kinds of ratio models were developed and tested in the project that forms the main source of this Guide. Five such ratios have proven to have general utility. When these measures are taken together, they give a full description of a work group's performance. The measures are effectiveness, quantity, quality, value, and change.

What follows is some further discussion (with examples) of each of the five ratios.

Measures of Effectiveness

The basic model for this kind of measure is:

ACTUAL/PLANNED

Measures of effectiveness are measures of achievement against pre-set goals. Most managers are very familiar with effectiveness measures. They can readily identify progress toward achieving goals, meeting milestones, filling vacancies and reaching targets of various kinds. They can identify end results, like projects and programs, and how well they have performed against a program or project plan. They can tell if they have stayed within budget, within schedule, and within technical requirements.

Examples of effectiveness measures:

PROJECTED FACILITY OPERATION TIME/ACTUAL OPERATING TIME

MILESTONES REACHED/MILESTONES PROJECTED

NUMBER OF TESTS COMPLETED/NUMBER OF TESTS PLANNED

PROJECTED BUDGET/ACTUAL BUDGET

NUMBER OF CONTRACT ACTIONS REQUIRED/NUMBER COMPLETED

MINORITY CONTRACT DOLLAR GOALS/VALUE OF CONTRACTS AWARDED

NUMBER OF QA INSPECTIONS PLANNED/NUMBER COMPLETED

Measures of Quantity

The basis model for this measure is:

PROCESS OR PRODUCT UNIT/SOURCES OF COST

Measures of quantity are the kinds of ratios that are typically derived from the traditional output/input model. One slight modification in the denominator of the ratio proved helpful in building measures that had the most information for potential improvements. Rather than have managers consider "costs," they should identify as many "cost sources" as possible. When directed to identify sources of cost, groups list cost sources which they might have otherwise easily overlook, e.g., meetings, informal planning sessions, travel to inspection sites, preplanning time, and time waiting for decisions.

Examples of measures of quantity produced in the project and seminar are as follows:

NUMBER OF REAL-TIME DATA SYSTEM CHANGE REQUIREMENTS ISSUED/TOTAL COST OF HARDWARE AND SOFTWARE

TOTAL NUMBER OF WIND TUNNEL TESTS RUN/FACILITIES MANAGEMENT COST

WEIGHTED DESIGN REVIEWS/COST OF PROFESSIONAL STAFF HOURS

NUMBER OF QA INSPECTIONS/COST OF PLANNING, TRAVEL, REPORTING SPACECRAFT WEIGHT/CONTRACTOR COST PER UNIT OF WEIGHT

SOFTWARE PACKAGES ISSUES/COST OF PROJECT PLANNING MEETINGS, TIME WRITING CODE, TIME DEBUGGING CODE

AVERAGE TIME IN PROCUREMENT CYCLE/MANPOWER COST

Measures of Quality

Quality is actual performance compared to the stated or hoped for performance of a process or product. Measures of quality are measures of system and product reliability, measures of error, measures of failures, etc.

The basic quality ratio model is:

INDICATORS OF ERROR OR NONCONFORMITY TO SPECIFICATIONS/ PROCESS OR PRODUCT UNIT.

Examples of quality measures are as follows:

SUM OF WEIGHTED MALFUNCTION INFORMATION REPORTS/SCHEDULED SYSTEM OPERATION HOURS

ANOMALIES/SOFTWARE SYSTEMS DEVELOPED

MISTAKES IN WORK PACKAGES ISSUED/WORK PACKAGES ISSUED

UNPLANNED DOWNTIME OF FACILITY/PER TEST

ERRORS IN SAFETY INSPECTION REPORT DETERMINED BY FOLLOWUP CHECK/PER SAFETY INSPECTION REPORT

MISTAKES IN DELIVERED ORDERS/ORDERS DELIVERED

NUMBER OF TIMES MATERIALS REQUESTED/NUMBER OF TIMES NOT AVAILABLE

Measures of Value

Value is inputted to a service or product by the user of the service or product. The degree to which users value a service or product can be determined in a number of ways--the most obvious of which is to ask the user.

The ratio model for value is:

DESIRABILITY/SOURCES OF COST

Examples of value measures are as follows:

MEASURED CUSTOMER RESPONSE/COST OF TRAINING PROGRAMS

NUMBER OF CITATIONS/COST OF PUBLICATIONS THAT CAN BE REFERENCED

SAVINGS FROM SUGGESTION PROGRAMS/MAN-HOURS TO REVIEW SUGGESTIONS

INTRODUCTION OF ELECTRONIC MAIL/SAVINGS PER ITEM DELIVERY

WEIGHTED EVALUATION OF SERVICES/COST OF SERVICES

Measures of Change or Improvement

Measures of change are statements of performance improvement goals. They are largely derived from the information obtained from the indexes that are developed by tracking the same performance measure over some time period.

Examples of improvement measures are as follows:

INCREASE BY X% NUMBER OF DOCUMENTS PREPARED/PROCUREMENT CLERK

REDUCE BY X% FACILITIES DOWNTIME/EACH TEST

DECREASE BY X% AVERAGE TIME/INSPECTION

DECREASE BY X% AVERAGE TIME/TEST TO PUBLICATION

APPENDIX A

SMALL-SCALE MEASUREMENTS STUDY

This project was undertaken by Commonwealth Training Associates for NASA Headquarters and was conducted by Dennis C. Kinlaw. The project involved the following branches:

KENNEDY SPACE CENTER

Data Processing and Integration Branch
Propellants and Life Support Branch

LANGLEY RESEARCH CENTER

Propulsion and Aerodynamics Branch
Fatigue and Fractures Branch

Project Design and Objectives

Objectives

The objectives of this project were (1) to test alternative structured processes for use by work groups to develop productivity and quality measures; (2) to develop a set of productivity measures with selected NASA work groups; (3) to test the utility of these measures in these work groups for a period of 4 to 6 months.

Operating Guidelines

The following guidelines applied to the project:

1. The purposes of this project were to test ways to develop measures and to test the utility of measures developed. It was not the purpose of this project to evaluate anyone or any work group.

2. Data retrieved from participating work groups were controlled by the work groups and by their respective centers.

3. Data were shared among participating groups (as permitted by each group).

Project Tasks

The project included the following tasks:

1. Brief senior managers and Productivity Focal Points at the two NASA installations involved in the project.

2. Identify work groups which would participate in the project.

3. Brief the head of each participating work group and develop agreement for ground rules and general schedule for proceeding with the project.

4. Hold initial meeting with each work group, brief each work group on the design and objectives of project, develop agreement on milestones, and complete first iteration of developing measures.

5. Hold additional meetings with each group (or the representatives of each group); test with each group two or more working models of productivity and quality measures; modify models with each group and try to build a model that could be generalized for NASA's application.

6. Test at least two alternative structured group processes for developing measures.

7. Set each group up to test the use of the measures developed and to record its experience.

8. Provide consultative help to each group during the life of the project to make whatever corrections in the design or schedule of project may be needed.

9. Collect progress data from each group during the project and communicate this to participating groups, to respective Productivity Focal Points and to NASA's Productivity Office.

10. Submit final results to participating groups, to respective Productivity Focal Points, and to NASA's Productivity Office.

General Results

This project was undertaken to achieve a few clearly specified results. But, in the process of trying to secure these results, a number of other results were achieved that, in the long term, may prove to have the greater utility.

The general results from the project were as follows:

1. All groups developed measures which they considered to have potential utility.

2. The most common ratio measure for productivity, OUTPUT over INPUT, proved to be too simple and actually confused the process for developing measures. This traditional ratio model does not provide the specific guidance that is required for

developing measures in complex environments like not-for-profit scientific and engineering organizations, e.g., NASA.

3. There are at least five distinguishable types of ratios that measure some part of total performance. These are measures of effectiveness, quantity, quality, value, and change.

4. The perspective for developing measures is greatly enlarged by using an open systems model of the organization.

5. Groups can employ a variety of sequences, methods, and techniques for developing measures so long as certain elements in the group process are preserved and so long as the group operates with certain qualitative characteristics. The elements include an accepted rationale for measures; a technical model for measures; examples of measures; information generating techniques; and an open systems model of the organization. The qualitative characteristics of a group that support the development of measures appear to be the ability of the group to develop a structure for operating, e.g., norms for interacting and making decisions; and the ability of the group to make full use of all the resources represented by group members; and the ability of group members to conduct problem-solving conversations, i.e., conversations that concentrate on developing information, that track a rational sequence, and that are free of irrelevant and judgmental inputs.

6. In the research environment, value is largely determined before the fact, i.e., by the process in which research projects are conceived and funded. This suggests that considerable attention must be given to ensure the efficiency and effectiveness of the research selection and implementation process.

7. There is considerable confusion about NASA's interest and commitment to productivity. This is particularly true in relation to measures. There is no clear organizational imperative that people are asked to respond to. People want to know, is there a grand scheme? Does NASA really plan to use measures? If so, when? Simply put, neither the agency nor installations (with perhaps one exception) have strategic plans. Without some such plan to focus purposes and resources, the attempt to develop measures will always be a haphazard and casual enterprise.

8. It will probably not be practical to use output measures in a research environment for periods of less than 3 years. Research and test projects typically extend over 3 to 5 years and the value of these projects may not be known for many years after that.

9. Measurement can have a positive impact on NASA managers, but it can also become one of the most destructive initiatives that NASA might undertake. Many NASA managers are still smarting under the Civil Service Reform Act and resulting performance appraisal system. They see productivity and quality measures as

another system that is peripheral to their real work and one unlikely to have a positive impact on performance. The fear is that measurement will become a tool for "measuring" and not for "improving." The fear is that managers in NASA Headquarters will use measurement as a way to control and punish and not as a way to ensure quality and productivity in research and development. What and where is the agency's strategy for introducing measurement into a system that has such fear and resistance to such a prospect?

10. It is possible to develop measures of performance in all work environments similar to those used in the study. The biggest problems are lack of good models, technical descriptions of measures and examples; lack of experience that suggests that measures benefit work group performance; and lack of skill in developing measures.

Measures of Total Performance

Ratio group measurements were developed in all of the groups. Examples of these measures are found in the MEASUREMENT RATIOS section of this Guide.

APPENDIX B

NASA'S PRODUCTIVITY IMPROVEMENT AND QUALITY ENHANCEMENT SEMINAR

Program Characteristics

NASA's Productivity and Quality Enhancement Seminar has the following general characteristics:

1. It was developed with the involvement of NASA managers and NASA Contractors.

2. It was targeted for use with all NASA managers and their Contractor colleagues.

3. It provides for extensive discussion by participants and application of key concepts and methods for improving individual and work group performance and for implementing change.

4. It was designed for delivery to a variety of individual and work group configurations.

Purposes

This seminar has three general purposes:

1. To provide managers information about special productivity and quality enhancement initiatives being undertaken by NASA and NASA Contractors.

2. To acquaint managers with a number of ideas and tools that have proven useful in managing the productivity and the quality of output of work groups and organizations.

3. To provide managers with ideas and tools for introducing and managing change.

Assumptions

This seminar was designed with the following assumptions:

1. NASA managers and their Contractor counterparts have always been committed to the tasks of improving productivity and enhancing the quality of the various kinds of scientific, engineering, and administrative results that they produce. This seminar assumes that NASA and its Contractors are interested in finding additional tools and resources to fulfill this commitment.

2. This seminar is expected to be a positive and upbeat experience for managers. It is assumed that NASA and Contractor

managers have much to share with each other about their performance successes and that they want to communicate their ideas about productivity and quality enhancement to each other.

3. There is a tremendous amount of creative ferment going on in America's scientific and engineering organizations, business firms, manufacturing groups, and Government agencies. America is experiencing a rebirth of commitment to excellence. New ways of doing business are being tried and a great deal of new information about organizational effectiveness and superior management practices is being discovered. It was assumed in designing this seminar that NASA and contractor managers want to know about the ideas on quality, productivity, and change that are surfacing.

4. Developing new and better ways of doing business is clearly in the national interest. Producing the best product--research, technology, flight hardware, and so on--with the minimum use of expendable resources is critical to the country's growth, to her defense, and to maintaining or increasing our standard of living. This seminar assumes that NASA and contractor managers want to contribute to the Nation's general fund of ideas for quality enhancement, productivity, and change management.

5. Change management, quality enhancement, and productivity improvement do not occur through short-term programs. They occur through processes that are dedicated to improving organizational performance over the long term. For this seminar to have general benefit, it must be viewed as a catalyst to encourage NASAS managers and Contractor managers to integrate change management, quality enhancement and productivity improvement initiatives into their ongoing management systems and activities.

Description

This seminar is a special initiative developed through the cooperative efforts of NASA Headquarters (Director for Productivity and the Office of Development) and NASA. NASA and Contractor managers participate fully in planning and delivering this seminar. It has a series of core sessions which are intended to be augmented by brief presentations and topics of special interest. The core sessions are delivered by a professional consultant.

The four core sessions are as follows:

- PRODUCTIVE ORGANIZATIONS AND SUPERIOR MANAGEMENT PRACTICES
- GETTING PEOPLE INVOLVED
- MEASURING PERFORMANCE

- MANAGING CHANGE

These core sessions are augmented by presentations on:

- CONTRACTOR AND NASA PRODUCTIVITY IMPROVEMENT AND QUALITY ENHANCEMENT INITIATIVES.

APPENDIX C

RESOURCES

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